The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. XLVIII
No. 1236

SATURDAY, MARCH 6, 1943
REGISTERED AS A NEWSPAPER

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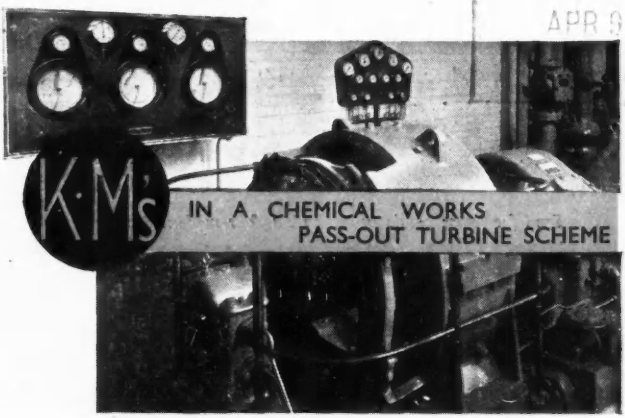

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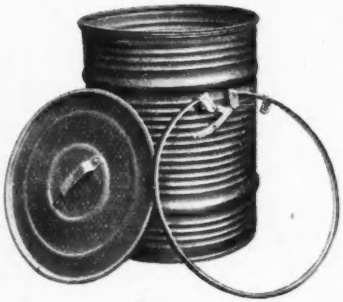

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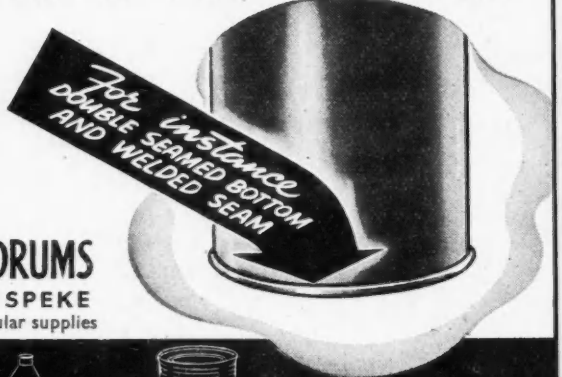

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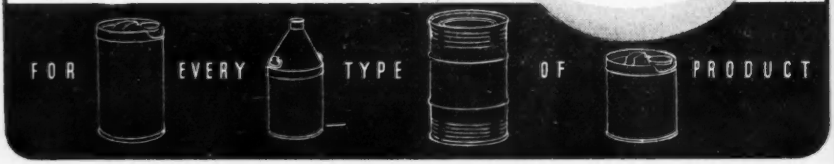

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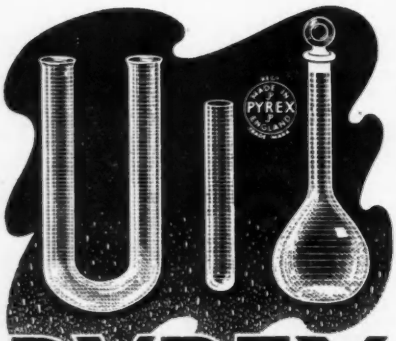

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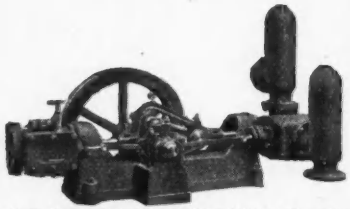

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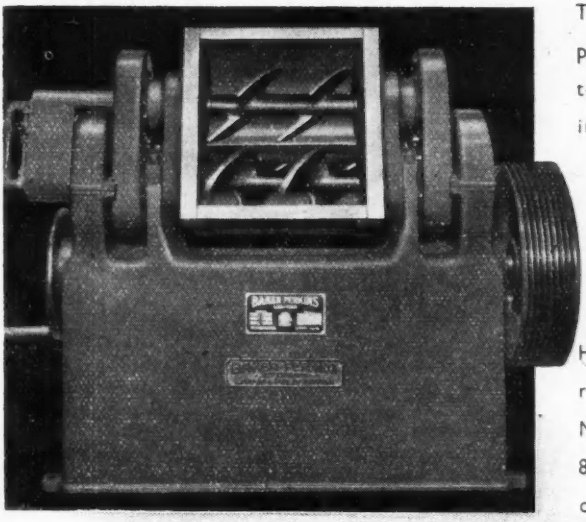

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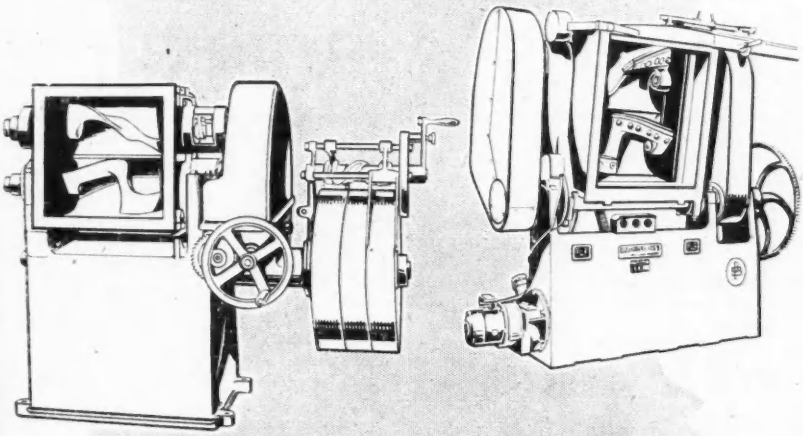

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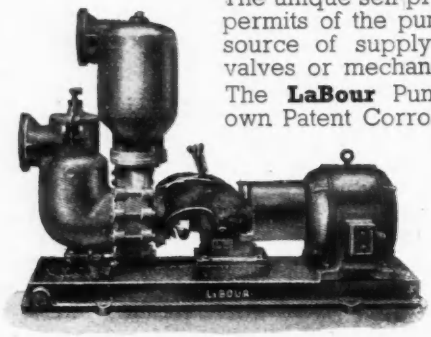

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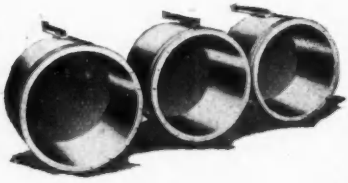

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VOL. XLVIII
No. 1236

March 6, 1943

Annual Subscription 21s.
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Light Metals

BERYLLIUM, magnesium, boron, and aluminium form a little square in the periodic table comprising the first two elements in groups II and III, all of low atomic weight, and all having little more than scientific interest 30 years ago, when many of us "did" our elementary chemistry. To-day, two of these elements are among the most important in the whole range of industrial metals, and the other two may well become almost equally important.

Let us take boron first because it is in a rather different industrial category from the other two. Its use in ferrous metallurgy has been considered since 1907, but it was not until it was appreciated that very small amounts, of the order of 0.001 per cent., were effective in improving some of the properties of steel that it really came into use as an industrial element. The effect it produces is one of "hardenability"—that characteristic of a steel which determines the depth to which it can be hardened when quenched. The strength of any steel varies directly as its hardness, so that a shallow-hardening steel would have in any large section only a relatively small zone of high strength, the remainder being of low strength. Boron gives results which are said to be in every way comparable with those secured by the more conventional alloying elements, manganese, chromium, nickel, molybdenum, vanadium, and silicon. The importance of boron just now is that it can be used in place of other alloying elements of which there is a shortage, and it can help to increase the alloys available for making alloy steels needed for war purposes.

Beryllium has been described as "the metal that doesn't get tired." Aviation instruments, altimeters, and many parts of aeroplanes have wholly or in part been constructed of alloys of beryllium with copper on account of the fatigue-resisting properties secured in this way. It is used as an alloying element, particularly in non-ferrous metallurgy, wherever there are unusually high speeds or exceptional strains. The element itself is lighter than aluminium, harder than steel, yet so brittle that no use could be found for it until, a very few years ago, the properties of its alloys with copper were investigated. In consequence, the price of beryllium has dropped since 1929 from some £40 per lb. to £3 per lb. Beryllium copper has other useful properties besides its strength.

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Under conditions where iron tools might cause a dangerous spark, beryllium-copper tools are used. It is non-magnetic, which gives it a special usefulness in navigation, and it is highly resistant to corrosion. It has also the advantage of being malleable until hardened by heat treatment.

These two elements have still something of the nature of scientific rarities that are just coming into industrial use on the large scale. Aluminium, of course, has achieved that distinction, and there is no need to describe its place in technology to-day. In the 1880's its price was about 30s. per lb., and this was sufficient to prevent its immediate development. An electrolytic process, however, using molten cryolite, was introduced in America in 1888, and from then on progress was made until at the present time the price of the metal has been reduced to a few pence a pound. It is recorded that the Aluminium Company of America has been spending £200,000 a year on research, and other companies are now at work with a huge production programme.

Magnesium was the subject of the Peter Le Neve Foster memorial lecture at the Royal Society of Arts by Professor Desch, as recorded in our issue of last week. It is produced not only from ores, but also from sea water. It is potentially a most important fact that the supply of this metal is inexhaustible, since each cubic mile of sea water contains 4,000,000 tons of it. All the nations at war have substantially increased their production—the U.S.A. aims at a hundredfold increase for example—and this increase is not a war-time expansion only, but one which is bound to play a significant part in metallurgy and engineering after the war also. The largest magnesium plant in the world is under construction at Boulder Dam, and it is proposed to produce there 56,000 tons annually, or more than the world output in 1040. This is an example of international co-operation, for the owners of the Boulder Dam Co., Basic Magnesium, Ltd., are reported to have sent 45 engineers to England last winter to work at Magnesium Elektron, Ltd., for some months and to be trained to take charge of the American plant.

Magnesium is produced also from sea water, as we have said, and the process is undertaken in this country by British Periclase, Ltd., as was described by Dr. Desch. In the U.S.A. the Dow Chemical Company, who began to produce magnesium industrially in 1915 when the first world war cut off supplies that had previously come from Germany, have also taken up the sea-water process on a large scale. The Dow plant at Freeport, Texas (*see* THE CHEMICAL AGE, January 31, 1942), has been described as an engineer's dream: "Sea water to the extent of 300,000,000 gallons a day is pumped in from one side of a long neck of land. Not all of this is for magnesium: some is for bromine and some for cooling purposes. The waste water emerges at the other side, seven miles away. Oyster shells dredged near by supply lime. Salt is abundant; so also is electric power, and natural gas in that region sells for next to nothing."

The two most important groups of magnesium alloys, to quote Dr. Desch, are those in which the magnesium forms the principal element, the other elements being added to give the necessary mechanical properties; and the alloys, consisting chiefly of aluminium, in which magnesium is present to the extent of 5 per cent. or more. The alloys in which magnesium forms the primary metal are characterised by their extreme lightness, and also by their great mechanical strength. It seems that in magnesium, steel will have a very powerful competitor in many fields. The alloys in which magnesium is the secondary metal are highly resistant to corrosion. It is not possible to make an alloy of magnesium and beryllium, because the m.p. of beryllium is above the boiling point of magnesium, but the addition of 0.005 to 0.01 per cent. of beryllium to magnesium gives a marked degree of protection against oxidation of the molten metal.

The rise of these four metals to industrial importance is undoubtedly one of the romances of chemistry. The production of the metal from its ores in every instance is an achievement of chemistry, and if the subsequent working-up of the metal has become the field of metallurgy, that is strictly as it should be. The chemist has provided the engineer with a series of most valuable metals and alloys. The engineer in turn will return them to the chemist as materials of plant construction.

NOTES AND COMMENTS

Chemical Engineering Courses

A RECORD of progressive activity has come to be regarded as an essential part of the Livesey Professor's doings, and the report recently presented to the Coal, Gas, and Fuel Industries Committee of the University of Leeds by Professor D. T. A. Townend is no exception to this agreeable rule. Perhaps the best news for industrial chemists in this particular instance is the announcement that the recommended degree course in chemical engineering is now being put into effect. Last year the advisory subcommittee recommended ordinary and honours courses in gas engineering, chemical engineering, metallurgy, and fuel and metallurgy, as well as post-graduate courses in metallurgy and in chemical engineering, and these courses have been fully approved by the Board of Science and Technology of the University, as also by the Senate and Council. An interesting point in connection with the fuel-plus-metallurgy course, is that both the ordinary and the honours courses are scheduled to occupy four years. It has long been felt that it was impossible to provide an adequate course in the two subjects combined within the space of three years. In chemical engineering also, both ordinary and honours courses take up four years.

Fuel Technology Research

NEW experimental work on the study of the hydrogenation of coal at high temperatures will start during the course of the year, it is hoped, facilitated by the erection of the semi-scale plant for this purpose by the Woodall-Duckham companies. Keen interest has been shown in the constructional problems involved in translating this process from the laboratory. Dr. E. C. W. Smith, who has been researching into the emission from refractory materials in contact with flame, has been temporarily seconded to a Government position, but the field in relation to the possible use of materials showing selective emission as radiators in industrial heating and drying processes is being explored by Mr. R. Long, under Dr. Smith's direction. The purification of producer gas is under investigation by Mr. W. H. Hollis (under the direction of Mr. H. J. Hodsman) and the constitution of British refractory clays is being studied by Mr. E. Heaton, his research being aided by a grant from the D.S.I.R. A similar grant has been renewed to enable Mrs. K. Spence to continue investigations into the two-stage ignition phenomenon of higher hydrocarbons and their derivatives. Further progress has likewise been made in the researches on special steels and special cast irons, also on the effect of liquid steel temperatures and the high-temperature oxidation of alloy steels. All this takes up room; and new space requirements are heavy. Still, having in mind the difficulties of the present situation, we heartily agree with the Livesey Professor that progress can be regarded as satisfactory.

Essential Materials

ONE of three combined Anglo-American Boards set up in January, 1942, the Combined Raw Materials Board, has now issued its first report. When the Board was formed there was anxiety for our rubber, tin, and manila hemp supplies from Malaya and the Philippines; and the Netherlands Indies were in danger. The United States disturbed the balance of supply and demand for the principal metals, particularly copper and steel alloys, while the threat to India after the fall of Burma demanded urgent consideration concerning other materials, including jute, mica, shellac, and graphite. Losses could not be made good and so economies and restrictions were imposed in this country and America. Vigorous steps were taken to develop new sources, and it says much for the actions of the Board to know that real progress was made possible towards planned and expeditious utilisation of the combined raw material resources in the prosecution of the war. When the war ends will this co-ordination continue?

After-War Problems

THE Board in its report says that consultations were held with the shipping authorities to avoid shipping waste, and an instance of the saving of tonnage is that effected by the substitution of the shipment of phosphorus from the U.S. to Britain in place of phosphate rock, and, at the same time, releasing capacity here previously devoted to the manufacture of phosphorus for the pro-

duction of ferro-silicon. Recommendations covering about thirty strategic materials were made by the Board, whose conclusions may help to solve the world-wide scramble for raw materials after the war, according to Mr. W. L. Batt, vice-chairman of the U.S. War Production Board. Mr. Batt was one of two men who had the task of planning the development, expansion, and use of raw materials for the Combined Board, and his conclusions are worth considering. Only time will tell whether the problem is solved or whether there is to be another rush "by all nations for available supplies."

Colour-Blindness

COLOUR-BLINDNESS was mentioned during a discussion following a paper at the London Section of the Oil and Colour Chemists' Association in London recently. The question was asked whether it had been established that women were more, or less, colour-blind than men. Mr. E. R. Wells, who read the paper, said that colour-blindness in females was a comparative rarity. It would appear that the question is more a matter of individuality; some females have a happy knack of being quick in picking out colours that blend, or have a natural inclination for colour, and the same remark applies to males. Prior to the advent of the W.R.N.S., the male personnel of the Royal Navy Signal Service (semaphore and flags), had to be expert on colours. The failures on account of colour-blindness were few, and these were found out by preliminary tests; and there is no reason to suppose that the proportion of successful candidates among the women is any higher to-day.

Special Gifts Neglected

ANOTHER comment was made during the discussion by the chairman, Dr. H. W. Keenan, who pointed out that very often the opportunity of doing colour matching was given to too few people. There were people who claimed no special qualifications for this, yet had an uncanny knack of being able to say accurately whether there should be a little more yellow or other colour. Quite a number of valuable people might be wasted by not giving opportunities to more operatives. It is possible that the gifts of many people have been thus neglected in the industry in the past, but it is up to managements to prevent it in future. The question is "How can it be managed?" A simple colour test for all operatives joining the paint manufacturing industry might solve the problem.

New Uses of Glass

A SECTION of the exhibition opened recently in London by Sir E. Owen Williams, K.B.E., to illustrate the latest applications of glass to modern industry, is devoted to chemical engineering. The exhibition was arranged by the Department of Glass Technology of Sheffield University, in conjunction with the Glass Manufacturers' Federation and the Building Centre. The equipment on view includes Pyrex molecular stills and taps, all-glass cells for spectrophotometric measurement, and chemical apparatus with interchangeable ground. A feature of the last product is the use of glass joints which allows for the replacement of parts when worn or broken. A point of importance in war time for using glass for many purposes that have previously necessitated other materials is that all the necessary ingredients can be obtained in this country. Less fuel, too, is needed for its processing than in the fashioning of equipment from the metals hitherto in customary use.

The "Food Yeast" Process

THE simplicity of the plant which is producing *Torula utilis*, the new "food yeast" for the Chemical Research Laboratory of the D.S.I.R.—which was discussed in our news columns last week—gives little inkling of the importance of this final stage in research work that has covered a period of over two years. To the waste molasses which are being used in the work is added nitrogen in the form of ammonia or ammonium salts. Production is extremely rapid. By using improved methods developed at the Laboratory, manufacture of food yeast proceeds continuously. A solution of molasses and the necessary ammonia and phosphate are poured into a vat at one end, and, at the other end, an equivalent volume of yeast in suspension is withdrawn. Before it is dried it is carefully washed to remove waste products. In this way full use is made of the rapid power of growth possessed by the micro-organisms. The "yeast" comes off the roller in flakes of a pale straw shade.

Petroleum in the Chemical Industry

A Raw Material for the Future

by J. E. WALKER

FOR a great number of years coal tar has been regarded as the raw material *par excellence* for the manufacture of organic chemicals and intermediates. To-day, it is still of paramount importance, but its undisputed supremacy is being severely challenged and is undoubtedly in grave danger. The new challenge is from petroleum, in its various forms, which bids fair to surpass coal tar completely as a basis for the manufacture of chemical compounds. In fact, at least one set of figures has recently been published in America, claiming that petroleum has already surpassed coal in this field, but since no indication has been given as to how these figures were calculated, too much importance should not be attached to them. But such a statement does at least indicate the present-day trend, and the main fact remains that, for the preparation of a really immense number of organic compounds, petroleum in its various forms is becoming of increasing importance. In the very near future it will become a raw material with which the bulk of chemical manufacturers will have to reckon, and an examination of its potentialities, together with its availability and easy handling, should make it an attractive proposition to a steadily increasing number of users.

A Vast Subject

The following article is an attempt to outline briefly, and it is feared in a most inadequate fashion, the amazing variety of possibilities offered by this raw material. The subject has already become so vast that it would be impossible to do it justice as a whole in anything less than a long treatise, which would have to cover, incidentally, a large portion of organic chemistry; but an effort will be made to give a general indication of the present position, and without doubt those interested will be able to visualise the immense possibilities for the future.

Some of the processes mentioned will be already proven commercially; others will be in the semi-commercial stage; yet others will still be practicable only in the laboratory. Little distinction will be made between them here, since to-day's laboratory process is to-morrow's commercial success. Thus it is hoped that this brief survey will not only be of general interest, but that it may also help to stimulate further interest in what the author believes to be the future basis of the chemical manufacturing industry. Apologies should be made here for the lack of many details in some of the processes mentioned. Under present world conditions much information on new and improved processes is naturally very scanty, even entirely lacking, and the reader's indulgence is therefore requested, since this at least is not the fault of the author!

Three Groups of Compounds

Petroleum, as a raw material for the manufacture of chemical compounds, can be divided into three main groups:—

(i) Natural gas.
(ii) Naturally-occurring mixed liquid hydrocarbons.
(iii) The products of thermal and catalytic cracking of both gaseous and liquid hydrocarbons, together with the results of isomerisation treatment, and catalytic cyclisation.

A fourth subsidiary group should be included, covering those substances occurring in petroleum as impurities, and eliminated during the usual refining processes.

The actual manufacture of organic compounds can be conveniently divided into three groups:—

(i) Compounds resulting from the thermal decomposition of petroleum, either by heat alone, or by heat and catalysis, and for the sake of convenience, these will be classed as primary products.
(ii) Compounds formed from petroleum, liquid and gaseous, and from the primary products, by such processes as oxidation, hydration, hydrogenation, nitration, etc., which will be called secondary products.
(iii) Compounds formed by the inter-

action of liquid and gaseous petroleum, the primary and secondary products, with such compounds as the halogens, sulphur, phosphorus, chlorine, acids and alkalis, etc., etc., will be classed as tertiary products.

It will, of course, be realised that this classification is purely arbitrary, and open to many criticisms. For instance, it has been found practically impossible to classify the products of esterification, polymerisation, and condensation reactions, as all these occur to a greater or lesser degree under groups two and three; it was therefore decided not to classify these compounds rigidly, and if certain discrepancies of classification occur in the text as a result, this point should be borne in mind.

I.—The Primary Products

As a raw material, petroleum gas, or natural gas, is probably one of the most interesting, for a variety of reasons. Its occurrence is widespread, its transportation over long distances comparatively easy through pipe-lines, and it is available in enormous quantities, *e.g.*, the consumption of natural gas in the U.S.A. alone in 1940 was approximately 2,500,000 million cubic feet. While it is found in greatest quantity in and near the great oil deposits of the world, it is also found in many places where there is no commercial production of oil. Thus a country or district entirely lacking in liquid petroleum, might find itself the owner of an extremely valuable material, on which an important industry could be built.

Constituents of Natural Gas

Practically without exception, the chief constituent of natural gas is methane, but the richer gases contain correspondingly higher percentages of ethane, propane, butane, and *iso*butane; but as a general assumption it can be said that at least there will be twice as much methane as other hydrocarbons together. Therefore, in considering the thermal decomposition of natural gas, we are primarily considering the decomposition of methane, and secondarily that of the other lower paraffins. Nevertheless, so huge are the volumes of gas dealt with, that even a small percentage of these masses assumes large proportions during the course of a year. For example, the natural gas from the Turner Valley oilfield in Canada, has an estimated yearly yield of some 70,000,000 gallons of butane, while cracking can increase this by a further 45,000,000 gallons per annum; truly a most useful supply, bearing in mind the requirements of the synthetic rubber industry.

Before dealing with the decomposition of natural gas, it should be noted that by high-efficiency fractionation, together with refrigeration, methane, ethane, propane, and butane can be physically separated, so that the decomposition of pure compounds as well as the mixed natural gas should be considered.

Methane Decomposition

Methane itself can be decomposed by the action of heat alone, the chief product being hydrogen. Very considerable doubt appears to exist as to whether the other product of decomposition consists of methyl or of methylene radicals. In all probability it will depend on the temperature of reaction, temperature control, and rate of throughput, and that, according to these conditions, either or both may be produced. However, it can be taken that the simple thermal cracking of methane yields hydrogen only as a pure product, and the balance is usually present as a sticky polymerised substance of unknown composition. A more suitable method might lead to the production of some new compound, if the polymerising effect could be prevented or controlled.

Methane can be decomposed also by the glow discharge method and then the products are mainly of an acetylenic nature. A similar treatment of ethane yields ethylenic compounds, but as both gases tend to yield each other's products, little progress seems to have been made here; it should prove, however, an interesting problem for research.

Besides methane, as already stated, petroleum natural gas contains varying amounts of ethane, propane, butane, and *iso*butane. Applying methods of thermal decomposition to these hydrocarbons either singly or in admixture, the resulting products are respectively ethylene, propylene, butylene and *iso*butylene, and these olefines form the really important raw material for the synthesis of organic compounds from natural gas. The usual

procedure is to "crack" the gas as it is obtained, *i.e.*, as a mixture, and the methods of doing this are probably numbered by the score at least. They can roughly be divided into two main groups however; thermal cracking, and heat with a catalyst, *i.e.*, catalytic cracking.

Temperatures vary greatly, as low as 110° C. with a catalyst being known, and as high as 1200° C. without catalytic assistance. A very large number of substances have been patented as catalysts, including mercury and chromium salts, aluminium chloride, platinum and palladium, potassium carbonate, "activated" aluminium silicate, and silica gel on thoria for some high-temperature catalytic processes. It can safely be said that there is a suitable process for any type of gas available, and that the products of cracking will be, in the main, olefines and hydrogen, together with unconverted raw gas.

Choosing a Cracking Process

The selection of a suitable process will primarily depend on the composition of the cracking stock. For example, a gas rich in butane would obviously offer scope for an isomerisation treatment for the production of *iso*-butane, and modified metal halides of the Friedel and Crafts type have proved very satisfactory for this process. Alternatively, the gas could be cracked to produce a good yield of butylene, which then could be isomerised to *iso*butylene. This brief example will at least give some idea of the numberless possibilities available. A point worth noting is that certain vapour-phase methods of thermal cracking have yielded, with slight modifications of operation, appreciable quantities of butadiene, of paramount importance in the manufacture of synthetic rubber, but fuller details appear to be lacking. The cracking of butane at pressures around 150 lb./sq. in. and temperatures of some 600/700° C., using a chromium oxide catalyst, also yields butadiene. On the first cycle, a yield of 65-70 per cent. of butylene is obtained, and this is re-cycled to obtain a yield of some 70 per cent. of butadiene, representing a yield of about 45 per cent. on the butane charged. In considering the cracking of natural gas, isomerisation should always be remembered as a method of increasing the yield of desired products, and cracking and isomerisation processes are frequently worked side by side. Thus on the first step of the examination of petroleum as a raw material, we have, as primary products, methane, ethane, propane, and butane, by fractionation, and hydrogen, ethylene, propylene, butylene, *iso*butylene, and butadiene by cracking and isomerisation —quite a promising start.

A Complex Mixture

Turning to liquid petroleum as a source of raw material, we are presented with an outstanding difficulty. Whereas natural gas consists of a comparatively small number of hydrocarbons in admixture, separable by fractionation, liquid petroleum consists of a most complicated mixture of scores of different hydrocarbons, consisting mainly of paraffins, olefines, cyclic paraffins, and aromatics. Commercially, little appears to have been done in separating these various hydrocarbons in a pure state, although many have been prepared in the laboratory. With improved technique, it may be possible to obtain comparatively pure liquid hydrocarbons from oil, which would then serve as valuable raw material for further processes. The cracking of liquid petroleum has a double effect: it greatly increases the yield of olefinic and aromatic hydrocarbons, and also leads to the production of hydrocarbons not originally present in the charging stock.

Modern cracking methods are, as before stated, divided into two categories: thermal decomposition and catalytic cracking. While it is believed that at the moment the former is the more widespread, the latter is undoubtedly of greater importance, and is constantly supplanting the non-catalytic processes. Thermal cracking of petroleum has been carried out for many years in order to produce a motor fuel of lower "knocking" tendency by increasing the content of aromatic hydrocarbons. Although liquid cracked products contain more potential raw material for the production of organic compounds than does ordinary crude oil, the complexity of the mixture is even more pronounced. Thus it is to a by-product of cracking, *viz.*, cracking gas, that we turn most frequently for our basic raw material. For many years this gas was burned, as a means of disposal; to-day, some processes are being

modified in order to increase the gas yield!

The yield of gas naturally, then, varies with the cracking process, and may be anything from 5 per cent. to 25 per cent. of the charging stock. Similarly, its composition will vary, and it is almost useless to attempt to give any really representative figures of analyses. While the composition of the gas is more complex than the original mixture of liquid hydrocarbons, being in the gaseous state it has proved more easily dealt with by various processes. Thus by fractionation, adsorption, absorption, refrigeration, etc., it has proved possible to separate it into its individual constituents. Also it has proved possible to treat cracking gas in its mixed form, as a primary product, especially when it is particularly rich in one desired component.

Thermal Cracking Procedure

Considering first the older process of thermal cracking, it should be remembered that the number of patented processes is very large, and it must be sufficient here to say that, in the main, they cover varying combinations of temperature, pressure, and contact time. Temperature varies from 150° C. to some 1200° C., pressures from atmospheric to several thousands of lb./sq. in., and time in contact with the heating zone from less than a second to several seconds. The usual procedure is to pump the pre-heated oil to be cracked through a "cracking" zone, usually in the form of a tubular coil maintained at the desired temperature and pressure. Speed of pumping controls the contact time, and is adjusted to give the maximum yield of desired products. The cracked products are then separated, by the use of various conventional methods, into gas, light hydrocarbons suitable for motor-spirit, and a residue frequently re-cycled, or sold as diesel or bunker fuel, according to its specification.

Better control and less production of undesirable constituents is claimed for the vapour-phase process, where the oil to be cracked is first vapourised, and these vapours led through the cracking zone. A patented process of this type cracks the vapours at 650/750° C., and the resulting product is separated into four fractions: (i) hydrogen and methane, (ii) olefines, (iii) cyclic hydrocarbons, and (iv) ethane and C_3 and C_4 hydrocarbons, the fourth fraction being used as a re-cycle stock.

Thermal cracking of liquid petroleum will yield those products obtained by the cracking of natural gas, but a most important point should be noted. Whereas natural gas is mainly paraffinous by nature, and so chemically very stable, no such statement holds good for oil, which will certainly contain olefinic, aromatic, and naphthenic hydrocarbons in addition. Thus, greater yields of olefines are usually obtained, and hence a greater quantity of the most important group of primary products. In addition, some yield of diolefines is frequently obtained by cracking oil, but rarely, if ever, on cracking natural gas, except for the production of butadiene. Summarising here, we have as products hydrogen and methane as usual, increased yields of ethylene, propylene, butylene and *iso*-butylene, and diolefines.

Catalytic Methods

Next for consideration is catalytic cracking. Progress here was rapid during the immediate pre-war years, and undoubtedly has continued since. Unfortunately, there is a great dearth of news on the subject at present, and the exact state of affairs is doubtful, but when circumstances again permit the usual free circulation of information, it is likely that amazing progress will be found to have been made. As with thermal cracking, very many processes have been patented, with a fourth variable, *viz.*, the catalyst, in addition to varying temperatures, pressures, and contact times. The original aim was, as before, the raising of the octane number of motor fuels by increasing their aromatic content, or the production of such hydrocarbons as *iso*octane. It is well known that great success has been achieved in these objects, since the bulk of our high-grade aviation petrol is the result of catalytic cracking, followed by either isomerisation, cyclisation, or alkylation, or combinations of these.

There are three main types of catalytic cracking: (i) the Fixed Base Method; (ii) the Fluid Catalyst Method; (iii) the Vapour Phase Method.

In the first of these, the cracking stock is led over the selected catalyst, which is suspended on some solid carrier, such as silica or alumina. The catalyst is

held in suitable containers, called reactors, which are maintained at the required temperatures and pressures. Contact time, as before, is controlled by throughput. Resulting products are finally fractionated. This process cannot be described as continuous, since periodic cleaning out of the reactors and regeneration of the catalysts is required.

The second, or fluid catalyst method is, however, continuous. The solid catalyst is mixed with the cracking stock, and the mixture circulated through a cracking zone, as before. The resulting products are separated by the usual methods.

The vapour phase method is probably most popular at present, owing to ease of manipulation. In one well-known process, for example, vaporised petroleum is passed over a catalyst consisting of activated hydro-silicate of aluminium. The resulting liquid product contains some 36 per cent. paraffins and *iso*-paraffins; 20-25 per cent. naphthenes; 23-26 per cent. olefines; and 16-20 per cent. aromatics. The gas produced contains comparatively large quantities of *iso*butane and butylene; and by slight alterations in operating technique, it is possible to increase the gas yield, and hence the yield of these two valuable hydrocarbons. Catalysts used are many and varied, but in the main are similar to those used in the catalytic cracking of natural gas.

Cyclisation

Regarding these processes from the standpoint of the production of raw materials for chemical synthesis, the gaseous products are as before, methane and hydrogen, comparatively large yields of olefines, and unconverted paraffins. The liquid products of main importance are benzene, toluene, and xylene. Other products of lower yield include *cyclo*-paraffins and diolefines. The various methods of cracking, thermal and catalytic, should nowadays always be thought of in connection with two other processes frequently used in conjunction with them. These are isomerisation, and catalytic cyclisation; and since these processes are worked in such close contact with cracking, the materials so obtained will be here classed as primary. There are several well developed processes for isomerising suitable hydrocarbons, and while this reaction is of considerable importance, catalytic cyclisation is probably of more immediate interest.

Briefly, catalytic cyclisation is a process whereby aromatic hydrocarbons may be produced from paraffins, olefines, diolefines, and naphthenes, and from varying mixtures of these hydrocarbons. It is thus one of the most important processes in connection with the manufacture of organic compounds from oil. As far back as 1915, toluene was being prepared from petroleum, by pyrolytic cracking over a nickel oxide catalyst, but compared with modern methods yields were low. At the present time it is possible to treat paraffins, *cyclo*-paraffins, olefines and diolefines by this process to obtain aromatics. For example, hexane will yield toluene; octane will yield xylene; and *cyclo*hexane will give benzene and toluene. Olefines and diolefines yield benzene, toluene, and xylene; and a process has been patented for the production of diphenyl from diolefines. Thus hydrocarbon mixtures of wide variety may be successfully cyclised, and the resulting aromatic compounds easily separated by fractionation.

As is usual with most catalytic processes, temperature and catalysts used show wide variation, and any attempt at an exhaustive survey would be impossible here. Thus temperatures can vary from 150° C. to 700° C.; and among catalysts used successfully may be mentioned chromium, vanadium, titanium, or molybdenum mounted on activated alumina; platinum, zinc oxide, and mixed catalysts such as chrome/copper/phosphorus.

Close control of the process is necessary, and for this reason, the operation is now usually carried out in the vapour phase, giving yields as high as 80 per cent. of aromatics from paraffins. However, some suitable naphtha charging stocks can be cyclised in the liquid phase, and from a total yield of some 80 per cent. aromatics, 15-20 per cent. of toluene can be separated.

Some Special Processes

Lastly, it should be borne in mind that there are a few processes, which although in most ways to be regarded as cracking processes, are slightly different, and can be classed therefore, as specialised pyrolytic treatments; they are frequently applied to one particular compound

rather than to a mixture of compounds. Even so, the distinction is vague. However, as examples, we have the catalytic dehydrogenation of *cyclo*hexane to yield benzene, followed by special heat treatment to obtain good yields of butadiene and ethylene. Similarly, specially selected light distillates from crude oil will yield acetylene and benzene, where the normal cracking processes would have given mainly olefines.

In concluding this first section, it is perhaps necessary to point out that although some of the products mentioned are the result of two or more separate processes, they are all essentially primary products, since they are all the result of breaking down, building up, or re-arranging the molecules of the hydrocarbons found in crude oil, and no new molecules have been added, as will be the case with the secondary and tertiary products. Yet we have a considerable list of these primary products on which to base the manufacture of chemical compounds, and to form raw material for the secondary and tertiary products.

While at the moment it would appear that the trend of industry is towards the production of *iso*paraffins and olefines, for the preparation of high-octane aviation petrol and of butadiene for the manufacture of synthetic rubber, present conditions cannot last indefinitely. Later will come the opportunity for other processes, and some of the primary products which are less in the limelight at the moment will emerge from their temporary eclipse, and become of great importance in manufacturing chemistry.

(*To be continued.*)

LETTERS TO THE EDITOR

Barytes

SIR,—Those of your readers whose daily life is concerned with the barytes industry must, like myself, have been interested to read the remarks made by your contributor, Mr. W. H. Reynolds, in part two of his article on page 199, in your issue of February 13, to the effect that there is a domestic minefield "which could be made to provide a tonnage of 50,000 to 100,000 tons a year, provided the owners were willing."

The recently formed British Barytes Producers' Association has been working in collaboration with a Government Department to ensure production of adequate supplies of barytes for the country's needs. The B.B.P.A. includes in its membership the owners of nearly all the developed mines of known importance.

If Mr. W. H. Reynolds knows mineowners who are unwilling to work a mine which could yield anything like the smaller quantity of 50,000 tons a year, mentioned by him, I hope he will regard it as a duty to notify the facts to the Ministry of Supply (Miscellaneous Chemicals Control), the Mines Department, and the Secretary of the B.B.P.A., 166 Piccadilly, W.1, so that steps can be taken to induce the owners of the minefield to make the ore available for the public use.—Yours faithfully,

L. P. O'BRIEN,
Vice-chairman of B. Laporte, Ltd.
Chairman of Malehurst Barytes Co., Ltd.

Luton,
February 25.

Co-operation in Plant Manufacture

SIR,—The leading article in your issue of February 6 struck a responsive chord in the minds of many of those engaged in the design and manufacture of chemical plant. There are no doubt directions in which developments have gone further in the U.S.A. and Germany, since each country develops processes and methods particularly suited to its own needs, but British makers are certainly not prepared to admit that generally they lag behind their foreign competitors.

They are, however, by no means satisfied that the spirit of co-operation, which is the main theme of your article, has been sufficiently developed in the past, and the British Chemical Plant Manufacturers' Association is at present actively engaged in exploring further possibilities in this direction. There is much to be gained by the closest possible collaboration between the users and the designers and makers of chemical plant, and the Association has this aspect of the problem very much in mind.

While individual plant makers have consistently co-operated with individual users, there is obviously scope for greater co-operation between the Association of British Chemical Manufacturers and the British Chemical Plant Manufacturers' Association, and it is hoped that your timely article will further this end.—Yours faithfully,

G. E. FOXWELL,
Chairman, British Chemical Plant Manufacturers' Association.

London,
February 25.

A new process by the Aluminium Company of America at Bauxite, Ark., has made it possible to extract from the lower grades of bauxite as high a percentage of aluminium as was formerly obtained from high-grade bauxite.

Metallurgical Section

Published the first Saturday in the month

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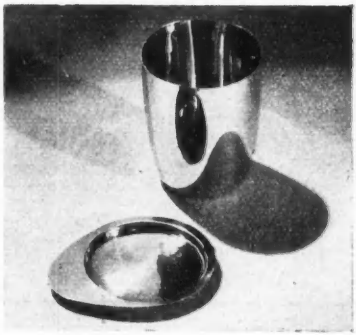

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Metallurgical Section

March 6, 1943

The Cycle of Non-Ferrous Metals

Recovery of Prevailing Types of Scrap

by O. EINERL, Dr.Eng., and F. NEURATH, Ph.D.

CONFUSION exists regarding what are called "secondary metals," in the absence of a more precise definition, and the part they play in war economy. What is primary in one process may be secondary in another and misunderstandings may thus occur. A broad distinction is to be made between (a) metals that are reclaimed from use, following discards and demolition; and (b) metals that are produced as scrap (clippings, cuttings, turnings, borings, grindings, etc.) in manufacturing processes which make an industrial cycle, but are still primary metals in the sense that they have *never been in use*. This cycle is obvious if the scrap is remelted and returned into operation in the factory where is was produced. It is not so obvious where the scrap is produced in a factory using alloys manufactured by suppliers (sheets, tubes, wire, extrusions, castings, pressed or forged alloys, etc.) and from which it may pass through the hands of merchants before returning to the primary manufacturer or proceeding either to a secondary alloy smelter or direct to a foundry.

Copper

Some of the copper that goes to the copper and brass mills begins to be converted into scrap during the production of unalloyed copper sheets, rods, tubes, etc. Such scrap naturally goes next into the manufacture of brass. Manufacture of brass sheets, rods, etc., results in more or less scrap, 25-30 per cent. on an average, in the processing of secondary manufactures. Such scrap returns largely to the primary manufacturer, and the cycle is then completed. Copper wires and copper cables are more in the nature of finished products and the return to them of process scrap is small. However, secondary manufacturers of copper wire or cables may have some scrap resulting from rejects, tangles, or other accidents.

Not all old copper wire goes to the refiners; some of it may be so cleaned and otherwise prepared as to go directly to brass founders and makers of bronze, brass, or gunmetal ingots from scrap metal. A large amount of copper is reclaimed from public utility (light and power) plant. Almost as great is the tonnage reclaimed from old telephone plant, but this material cannot always be used for making phosphor bronze or gunmetal as it often consists of a silicon-copper alloy containing 98 per cent. copper plus silicon. On the other hand, dismantled overhead transmission line may sometimes use, as conductor material, cadmium copper, containing about 1 per cent. cadmium and 99 per cent. copper, and this alloy is unsuitable for making brass sheets. Cadmium copper wire, for instance, is used for the trolley bus contact wires in London and for the tramway system in Manchester, while the grid lines crossing the Thames at Dagenham have conductors of phosphor bronze with a core of cadmium copper. Before using scrap copper wire, it is therefore always advisable to have it analysed.

Sources of Scrap

Motor-car radiators appear prominently in the list of scrap bought by refiners, and the importance of this source can be seen from the fact that the scrapping of 1000 motor cars results in about 30 tons of various non-ferrous scrap. Prior to the war, the U.S.A. alone scrapped between 2 and 3 million motor vehicles annually.

As a result of machining operations, large amounts of shell band turnings become available in war time, and as these are mostly contaminated with oil and iron turnings it is necessary to have them

dried and run through a chipping machine. After magneting they offer an excellent alloying material.

Gunmetal and Phosphor Bronze

Fairly large amounts of gunmetal and phosphor bronze scrap are always on the market. This material can be sorted and graded by experienced sorters and goes often directly to non-ferrous foundries. Much more difficult is the handling of turnings and borings, which are often badly mixed, and more care should be taken in machining shops to keep the different alloys separate. Contamination of gunmetal turnings with phosphor bronze turnings is especially to be avoided, and the presence of aluminium-containing material, *e.g.*, manganese bronze or aluminium bronze turnings, is very harmful to both metals. Care must be taken to exclude aluminium-containing material as far as possible, since over 0.03 per cent. of this element will produce excessive porosity in castings made from secondary alloys containing aluminium as impurity.

Silicon bronzes, such as P.M.G. metal (Vickers-Armstrong) or Everdur (I.C.I.), or other alloys covered by B.S.S. 1030/1942 constitute another danger for the re-use of gunmetal or phosphor bronze turnings. The same applies to silicon brass (DTD 263, 267, 307, 312) and the following simple test has been devised to distinguish between silicon-containing alloys and certain other alloys, particularly gunmetal. A small portion of the turnings or borings is placed in a test tube and covered with a 5 per cent. aqueous sodium nitroprusside solution. After boiling for 1 to 2 minutes over a Bunsen burner, the solution is decanted from the turnings, which are washed with tap water without being removed from the test tube. When a little hydrogen peroxide solution (1 per cent.) is added, the surface of silicon bronze turnings immediately turns dark blue in colour, while gunmetal is unaffected. This test will also differentiate silicon bronzes from tin bronzes, manganese bronze, or aluminium bronze.

Pure copper and copper-nickel alloys, including Monel metal, also give the reaction with sodium nitroprusside solution, but as the colour of these metals and alloys cannot be confused with that of gunmetal turnings there is small likelihood of a mistake.

Another war-time problem is the re-use of fired cartridge cases. Apart from the possibility that they might still contain explosive charges, these fired cartridges have generally been avoided in the past by manufacturers except for low-grade work. The detrimental effect of cartridge cases is due to the presence of small amounts of mercury and antimony, coming from the explosive mixtures used in the cap, where they may be present in the form of mercury fulminate and antimony sulphide. Most of the mercury volatilises (b.p. 338° C.) but sufficient antimony compounds remain to impair the impact values, the bending and riveting properties, and, to a lesser extent, the tensile strength and the elongation of brasses, in the making of which fired cartridge cases are used. The best way to utilise fired cartridge cases is to remelt and convert them into naval brass (nominal composition 62 per cent. Cu, 1 per cent. Sn, balance zinc) where small amounts of antimony have no detrimental effect, as the antimony will be dissolved by the addition of tin. Extruded bars made from such secondary naval brass give the mechanical tests conforming to B.S.S. 251/1940 for Admiralty naval brass.

The importance of the recovery of secondary metals salvaged after a period of service can be seen from the follow- figures published by the U.S. Bureau of Mines for the year 1941. The aggregate purchased copper and copper-alloy scrap consumed for all purposes in the U.S. amounted to 1 million tons. Of this quantity 52 per cent. was consumed by re-melters, smelters, and refiners, 31 per cent. by brass mills, and 17 per cent. by foundries and miscellaneous manufacturers. Secondary copper base products made in the U.S. in 1941 from new and old scrap amounted to over 900,000 tons and comprised 15 per cent. unalloyed copper, 33 per cent. copper alloy ingots, 34 per cent. secondary wrought copper alloys (brass and bronze sheet, rod, and tubing), 17 per cent. brass and bronze castings, and 1 per cent. chemical products. This, it is obvious, constitutes an important addition to the total metal supply.

Lead

Lead goes into use after relatively simple manufacturing operations; which do not result in much process scrap.

Large amounts of lead go into cable sheathings, and after a period of service the cable covering (and the copper core inside) can largely be reclaimed by a simple method of cable stripping. A large proportion, apparently about 75 per cent., of the lead that goes into automobile storage batteries comes back in a cycle of about 2 years. These battery lead plates, the moisture content of which should be as low as possible, contain also a certain amount of rubber, wood, and paper and are bought by refiners at a figure based on lead-plus-antimony content, less a treatment charge. The reclamation of lead from other materials is affected by the condition that some of the principal uses of this metal are of a dispersive nature, *e.g.*, the use of white and red lead for pigments, of lead for ammunition, and of lead for the manufacture of lead tetraethyl for anti-knock internal combustion engine fuels. Nevertheless, about 400,000 tons of scrap lead were recovered in U.S.A. in 1941.

Zinc

Secondary zinc recovery falls under two heads: reclamation from use and reconversion of by-products. The quantity reclaimed from use (new zinc cuttings, old zinc sheets) is relatively small. It comprises old rolled zinc from roof flashings, old linings of ice boxes and old litho- and photo-engraving sheets. The remelting of scrap zinc sheets is of more importance on the continent of Europe, where many old houses are still roofed with zinc sheet or are fitted with gutters made of zinc, although the development of the galvanising industry has widely displaced the use of zinc sheet even in Europe. There is no profitable method of recovering zinc from old galvanised iron, and that material must therefore be regarded as lost.

The major uses for rolled zinc (flashlight cells and glass jar tops) are also of a wasting nature; only the scrapping of automobiles into which zinc base alloy die-castings began to enter largely some years ago, is now returning a good deal of zinc alloy scrap of the Mazak type (alloy of pure crown zinc with additions of about 4 per cent. Al. 0.1-0.5 per cent. Cu and small amounts of Mg). To a limited extent the zinc derived from these sources goes to foundries and galvanisers, but more of it goes into the manufacture of zinc oxide, in both cases displacing virgin zinc, so that the economic result is much the same.

The reconversion of by-products of the galvanising process is of much greater importance. It may be estimated broadly that for each ton of zinc melted in the galvanising pot, only 16 cwt. comes out as coating on the iron and steel, while 4 cwt. or 20 per cent. comes out as dross (with 90-95 per cent. Zn), zinc ashes (70 to 75 per cent. Zn) and flux skimmings (45 to 50 per cent. Zn as zinc oxide, zinc oxychloride, and zinc ammonium/chloride). These several products may be redistilled (the boiling point of zinc is only 907° C.) as well as the hard spelter, resulting from the attack of zinc on the galvanising pots and contains about 4-10 per cent. iron, a little lead, and the balance zinc. Part of these by-products goes to manufacturers of lithopone, zinc chloride, zinc sulphide, and zinc sulphate. Modern plants for the remelting of old brass collect the escaping oxidised fumes containing large amounts of zinc oxide for the purpose of utilising it in the production of zinc white and lithopone.

Tin

The reclamation of tin as such is proportionately even less than the recovery of zinc as zinc ingots, for the reason that tin nowadays goes into few uses (collapsible tubes) from which it can be recovered by simple remelting. Now that tinfoil is being replaced more and more extensively by aluminium foil, collapsible tubes are almost the only source of tin scrap for direct recovery. Before the war about 50 per cent. of all tin used went into the production of tinplate, and in this process a good deal of the tin used goes into scruff and dross, from which it can be resmelted and returned into use in the plants where tin is produced. As a consequence of the present shortage of tin many detinning plants have been put into operation and a fair amount of pig tin can be salvaged in this way, a proportion also being recovered as stannous and stannic chloride. The principal source for the recovery of tin from use in the form of alloys (white metals and solders) constitutes a delayed cycle, as a large part of it comes back as solder and goes out again as such. Examples of this are in the radiators in automobile manufacture and in the soldered joints

of lead pipes. Other sources for the reclamation of tin are syphon tops and pewter tableware, etc., which contain over 80 per cent. Sn. The remelting of commercial tin-lead-antimony white metals leads to a eutectic tin alloy, which separates from the melt between 165 and 170° C. and can be used again in the manufacture of commercial solders. (Tin-Alloy). American statistics for 1941 show that 42,000 tons of secondary tin as metal and in alloys were recovered, 23 per cent. of which was supplied by tin base scrap, 39 per cent. by copper base scrap, 23 per cent. by lead base scrap, and 15 per cent. by tinplate scrap.

Aluminium

Aluminium scrap, new and old, presents a problem of its own. It is not merely a question of the enormous variety of aluminium alloys which have appeared on the market during the last 25 years, and which contain alloying elements, desirable for some purposes, but objectionable in others; but there is an additional complication owing to the fact that pure aluminium and all its alloys have practically the same colour, thus making the sorting difficult. Furthermore, while it is possible to refine copper and its alloys, for example, should they have accumulated undesirable ingredients, by furnacing or by electrolytic methods, the cost of purifying aluminium, though feasible electrolytically, has been so far too high to make it a commercial proposition.

Therefore, as impurities, apart from magnesium to a certain extent, cannot for practical purpose be removed from aluminium, it becomes necessary to use aluminium scrap under the strict supervision of experienced metallurgists, by blending and remelting to existing specifications and by "diluting" harmful elements.

Aluminium sheet cuttings seldom consist of pure aluminium, even when they come from a reliable source. Apart from those rare cases when aluminium sheet cuttings or clippings are not mixed up with galvanised sheet iron cuttings (which can be removed by magneting) or even "staybrite" cuttings (which are non-magnetic), the cuttings may consist of several different aluminium alloys in a hard, half-hard, or soft condition and for this reason they cannot be readily distinguished from pure aluminium by the sorter. Magnesium alloy cuttings (electron sheets) may also be present. It is furthermore the present practice to use protective coatings, such as anodising or painting, on parts that are exposed to corrosion. In such cases it is advisable to make use of the following rapid spot tests, which can be carried out after only a little practical experience.

Spot Tests

(1) *Caustic soda spot test.*—The only reagent necessary is a 20 per cent. caustic soda solution. A few drops of this are placed on a carefully cleaned spot of the sheet, rod, wire or tube, allowed to remain there for 5 minutes, and then are washed off with water, when the following results may be observed:

(a) Magnesium alloys are not attacked by the caustic soda.

(b) Pure aluminium sheets and aluminium magnesium alloys of the type Birmabright RR 66 (DTD 170 A) or MG5, MG7, and D2 (James Booth) are etched white where aluminum has been dissolved.

(c) Aluminium alloys containing copper, nickel, or both show fine black particles on the etched spot, which are metallic copper or nickel, which remain undissolved in caustic soda, whereas the aluminium readily dissolves to form sodium aluminate.

(d) High-silicon aluminium alloys (*e.g.*, forgings for engine cylinders, Hiduminium S 12, DTD 324, etc.) show a grey-brown discoloration on the etched spot, which is the more distinct, in proportion as the silicon content of the alloy increases. (These silicon alloys contain either 5 per cent or 11-13 per cent. silicon). In case of doubt as to whether the particles are black or brown, a few added drops of dilute nitric acid (1 : 1) will dissolve the black particles of copper or nickel, but not the silicon.

(2) *Silver nitrate-ammonium persulphate test* (for manganese). After etching with 20 per cent. caustic soda for 5 minutes, the solution of the metal surface is transferred with a few drops of water into a clean glass beaker. The same spot on the metal is then etched with dilute nitric acid and after 5 minutes this solution is added to the caustic soda solution in the beaker. Blue litmus paper will indicate whether the resulting solution is already acid; if not, acidify with a small quantity of dilute nitric acid. Next add

a few drops of 5 per cent. silver nitrate solution and some crystals of ammonium persulphate and place the beaker on a hot plate. As soon as the temperature of the solution reaches 60-70° C. the red colour of permanganate appears in the beaker, becoming the more intense the higher the manganese content of the alloy. Duralumin and similar alloys contain about 0.5 per cent. manganese, the alloys DTD 213, 249, 269 (BA 60 A and BA 120 of the British Aluminium Co., NA 3 S and Na 4 S of the Northern Aluminium Co., and Birmabright II of the Birmid Aluminium Co.) contain up to 1.5 per cent. Mn., and can be recognised by means of this test.

(3) *Quinalizarine test* (for magnesium).—Some drops of concentrated hydrochloric acid are applied to the clean surface of the metal. As soon as the violent reaction has ceased, the solution is transferred to a clean glass beaker. A few drops of quinalizarine solution (20 mgm. 1, 2, 5, 8-tetrahydroxyanthraquinone in 100 ml. alcohol or methylated spirit) are added. The solution now shows a pink colour, which changes into blue after adding sufficient 20 per cent. caustic soda solution (as used for test 1). If magnesium is present, an intense blue precipitate is formed. Should only traces of magnesium be present in the aluminium alloy, the blue precipitate will form after slight heating of the solution. Duralumin (DTD 150) contains 0.4-0.7 per cent. Mg; Dural strips (DTD 270) and Dural tubes (DTD 273) contain 0.8-1.5 per cent. Mg; tubes for oil, petrol and gas starters (DTD 310A) contain 1-3 per cent. Mg; wire and rivets (DTD 303) about 5 per cent. Mg; and hard aluminium sheets and strips (DTD 177A; Mg, 7) up to 10 per cent. Mg.

Secondary Smelting Industry

A good quantity of scrap aluminium castings, such as crank cases, cylinder heads, pistons, connecting rods, etc., derives from the dismantling of motor vehicles, other aluminium scrap comes from industrial castings, die-cast parts, vacuum cleaners, pattern metal, hat blocks, and even handles of old pots and pans which are mostly very low-grade aluminium alloys. They often contain foreign materials, bushings, iron rings, bolts, screws, and much oil and grease. Port lights from dismantled ships still contain glass and putty. All these materials can be used again by the secondary smelters, an industry that has developed enormously as a result of the existing shortage of virgin aluminium.

Common Impurities

The most common and the most undesirable impurities in cast aluminium alloys are iron and magnesium. Iron forms intermetallic compounds with aluminium and the other alloying elements; these crystallise in needle form and make the alloy brittle, reducing its ductility. As the size and the shape of these crystals depend on the chill obtained during solidification, and sand castings cool relatively slowly, iron should be limited for good commercial sand castings, where good mechanical properties are desired, to not more than 1 per cent. Fe. On the other hand, iron has some advantages as an alloying element in aluminium alloys, provided that the silicon content is low (under 1.5 per cent.). Iron decreases the hot shortness of aluminium alloys, improves the tensile strength and hardness, and preserves the mechanical properties at elevated temperatures. Aluminium alloys which are subjected to sufficient chill during casting (die-casting alloys, especially for pistons) may therefore contain considerable amounts of iron (up to 2.5 per cent.). Pistons and other permanent mould-castings should therefore be kept separate from cast aluminium scrap, except such early pistons as were made from Y alloy, which is very low in iron.

Magnesium is the other harmful impurity in most of the sand-cast aluminium alloys. The magnesium content should be less than 0.1 per cent. in slow-cooling aluminium alloys. The reason for this is that magnesium forms, with the silicon in the aluminium alloy, an intermetallic compound which is fairly soluble in aluminium at higher temperatures and can be kept in solid solution by rapid chilling. The more rapid the chilling of the alloy, the more of this compound Mg_2Si will remain in solution and the greater is the hardening effect. This represents, however, an unstable condition of supersaturation and the aluminium alloy tends to revert to the stable state by precipitating the magnesium-silicon compound, a process which is accompanied by a general increase in hardness and by a sharp decrease in elongation and ductility. Slow-cooling

aluminium casting alloys should therefore have the lowest possible magnesium content, which makes the liquid alloy sluggish, and the solidifying alloy hot, short, and brittle. On the other hand, high-magnesium aluminium sand-casting alloys are being used which contain up to 10 per cent. magnesium with small additions of manganese, but without copper, nickel, or silicon or only traces of these elements.

Large amounts of aluminium borings and turnings return from machining operations. They may be turnings from aluminium rods or bars, mostly of the magnesium-containing Dural type, or they may result from the machining of sand- or die-castings. They contain bore oil, soap water, iron turnings, wood, paper, rags, etc., and, in consequence of frequent handling between the machine shop to the store room, and thence to the truck or lorry and to the merchant or the reclamation plant, the turnings become interlocked and often form firmly connected bales which cannot be magneted.

The turnings or borings, which are also often mixtures of several aluminium alloys, have therefore to pass a chip breaker, a centrifuge for disposing of the oil on the turnings, a drying drum, and a magnetic separator before they can be sampled. Freed from iron and steel, the analysed chips—sometimes after being mixed with another suitable lot of similarly treated turnings—proceed to the melting furnace. Fine turnings and chips, since they have large surface areas entailing a risk of burning and consequently of dross inclusions, which might be caused by readily oxidising alloying elements (nitrides of aluminium and magnesium and the like), are melted under a flux blanket.

Properly melted aluminium alloys, the gas content of which has been removed by chlorine treatment, can replace primary aluminium alloys in many instances, and no difference in properties will be found, provided that the composition of the remelted aluminium is comparable with that of the high-purity alloys made from virgin aluminium. Aluminium recovered from new scrap resulting from manufacturing operations in the U.S., according to American statistics, amounted in 1941 to 65,000 tons, while recovery of aluminium alloys from old scrap accounted for 43,000 tons in the same period. Remelters in the U.S. produced 84,000 tons of secondary aluminium alloys ingots in 1941, suitable for consumption in foundries.

Institute of Metals

Annual Meeting : Memorial Lecture

THE 35th annual meeting of the Institute of Metals was held at the Institution of Mechanical Engineers, London, S.W.1, on March 3, under the chairmanship of the President, Lieut.-Colonel Sir John Greenly. An abstract of the report of Council for the past year was read and the report was adopted. Since the last general meeting 53 ordinary members and 41 student members had been elected, the corresponding figures a year ago being 25 and 15.

Officers elected for 1943-44 were: *President*, Lieut.-Colonel Sir John Greenly, K.C.M.G., C.B.E. (re-elected; *Vice-presidents*, Dr. Maurice Cook, Colonel P. G. J. Gueterbock, D.S.O., M.C., T.D., and Mr. A. J. Murphy; *Members of Council*, Sir Clive Baillieu, K.B.E., C.M.G., O.B.E., Mr. J. Cartland, M.C., Dr. A. G. C. Gwyer, and Dr. C. Sykes.

The president then presented the Institute's platinum medal for the year 1943 to Dr. Harold Moore, C.B.E., a Fellow of the Institute, who read a paper on "Co-operative Research in the Metal Industries."

To commemorate the birth on March 3, 1843, of the distinguished metallurgist, Sir William Chandler Roberts-Austen, a lecture on his life and work was given after the above meeting by Dr. S. W. Smith, C.B.E.

The lecture was arranged jointly by the Institution of Mechanical Engineers, the Iron and Steel Institute and the Institute of Metals. Roberts-Austen, after training at the Royal School of Mines (1861-1865) under John Percy, acted as private assistant to Thomas Graham, Master of the Mint, for four years (1865-1869). His appointment, in 1870, to an official position at the Mint was followed, in 1882, by further responsibilities as Chemist and Assayer of the Mint. His widening interest in fundamental problems of physical metallurgy and the attention which was attracted by his presentation of the results of his experimental work led, in 1880, to his appointment as Percy's successor in the Chair of Metallurgy at the Royal School of Mines, and later, in 1889, to a decision of the Council of the Institution of Mechanical Engineers to set up an Alloys Research Committee to extend certain aspects of his work. He played an important part in demonstrating the value of pyrometric measurements and of metallographic technique.

Caustic Embrittlement

Results of Investigations into Steel Failures

A PAPER containing the results of experimental work on caustic embrittlement was recently presented to The Institution of Mechanical Engineers by Messrs. E. W. Colbeck, M.A., S. H. Smith, B.Sc., and L. Powell, B.Sc. The type of apparatus used was based on one employed in recent American work carried out by Straub and Bradbury. The solution to be tested was contained in a hollow sealed tubular specimen, heated to any desired temperature in the steam boiler range, and subjected to a tensile load by means of a spring.

It was not possible to reproduce the results claimed by Straub, but a number of examples of intergranular cracking were produced. Some of these were obtained when using dilute solutions containing amounts of NaOH and silicate such as would be found in boiler waters. There was evidence that embrittlement occurred more readily in poor-quality steel and under conditions of non-uniform stress distribution, but it was not possible to reproduce results with any degree of certainty.

A few experiments with an entirely different type of specimen were carried out; and in these, intergranular failures were also produced. The paper also contained a survey of the more important literature on caustic embrittlement published between 1935 and 1941.

Laboratory Tests

In an introduction to the paper, the authors state that during 1934, research work on caustic embrittlement was carried out in the laboratories of Imperial Chemical Industries (Alkali), Ltd. In this work a 40 per cent. caustic liquor obtained from a plant manufacturing caustic soda was used. Tests were carried out at temperatures between 100 and 125°C. at atmospheric pressure. Specimens of both acid and basic steel were employed, and were held in tension by a system of weights and levers. A large number of experiments took place, but in none of these was it found possible to produce caustic embrittlement. In those instances in which failure occurred at unexpectedly low loads, corrosion which was entirely transcrystalline in character was considered to be the factor responsible. This earlier work was finally abandoned because of the difficulties mentioned above.

In 1938 the authors were receiving an increasing number of inquiries in connection with caustic embrittlement; and the number of failures which could be attributed to this cause appeared to be increasing. It was therefore decided that work should be recommenced on this subject in the firm's laboratories.

In the interval a considerable amount of work had been carried out in America by two separate groups of investigators, and in addition, work had been started in this country by the Department of Scientific and Industrial Research. This work received support from industry and a technical committee was formed to consider the results as they became available. Although interesting results were obtained at the National Physical Laboratory and wide claims were being made by the American investigators, it was felt that none of these investigations quite answered the specific industrial problems in connection with caustic embrittlement which the authors were continually being asked to solve. Accordingly, a new investigation was planned during 1938, and the present paper describes the results of this work.

Survey and Conclusions

A detailed description followed of the types of apparatus and materials used, the experimental technique, and the results obtained on various types of steel. The authors summed up with the following general conclusions:

(1) No results were obtained which confirmed Straub and Bradbury's statement that the filler induced concentration of a dilute liquor in the capillary space. One or two cases of cracking occurred when using a dilute liquor and a filler, but concentration was caused by accidental leakage in every case.

(2) There was considerable evidence that the formation of embrittlement cracks was greatly assisted if the steel were stressed in a non-uniform manner, either through changes in section, local cold-work, or both.

(3) Poor-quality steel appeared to crack much more readily than good class "A" mild steel.

(4) Failures and cracking which occurred appeared to fall into two classes: the first was a genuinely intercrystalline attack, the cracks being fine, numerous, and free from oxide, and usually associated with a crystalline black deposit of magnetic iron oxide in the bore of the specimen. The second class took the form of fissuring of the attacked surface; the fissures were usually straight and blunt-ended; they were transcrystalline, often filled with products of corrosion, and might extend in the form of transcrystalline cracks, few in number, also filled with products of corrosion. The second form of attack was not considered to

be genuine caustic embrittlement, though it was obviously of importance; the conditions under which it occurs must be very similar to those which cause genuine intergranular attack.

(5) In the authors' experiments the second class of attack was most frequently shown by the "A" mild steel; some of the bright drawn steel specimens also showed similar features, which appeared sometimes to be associated with excessively high values of local stress (*e.g.*, exceptionally thin walls). Almost every example of what was considered to be genuine caustic embrittlement was produced in the bright drawn steel specimens.

Colours for Steel Scrap

Help in Sorting Alloys

A COLOUR scheme which, it is hoped, will assist in the segregation of essential alloy steel scrap more effectively has been devised by the Iron and Steel Control. In future the various grades will be distinguished by different colours, as follows: carbon (white), nickel (red), nickel chrome (blue), nickel chrome molybdenum (green), manganese molybdenum (brown), carbon chrome, ball bearing (black), chrome molybdenum (orange), stainless (pink).

Producing works are urged to do everything possible to avoid mixing alloy steel scrap with carbon scrap, and alloy steel scrap should be sorted into appropriate grades. Scrap merchants should make sure they do not mix grades when collecting. According to an official of the Iron and Steel Control, hundreds of tons of valuable alloys are being lost every week in steelworks because of poor segregation.

Cupola Furnace Practice

Economy in Design and Operation

A REPORT on "Fuel Economy in the Cupola Furnace" (External Report No. 233) is the first issued by the Ironfounding Industry Fuel Committee set up by the Council of Ironfoundry Associations, with the active co-operaton of the British Cast Iron Research Association and the institute of British Foundrymen. The aim of the committee is to assist the industry to obtain the greatest possible fuel economy in foundry operations without sacrifice of technical efficiency. It deals on a national basis with all foundry processes involving the use of fuel—melting, annealing, heat-treatment, mould-drying, mould and core stoving, etc.—and co-operates with various other bodies and committees able to advise, where necessary, on steam-raising, power production, space-heating and the use of electricity, gas, oil and solid fuel for purposes other than those involved in the above-mentioned foundry operations. Inquiries on any matter concerning foundry fuel economy or requests for advice should be addressed to the Committee's Fuel Officer, Mr. W. J. Driscoll, B.Sc., Alvechurch, Birmingham

The report in question deals with the cupola furnace which, when compared with other coke-fired furnaces, has a relatively high thermal efficiency. Sometimes, however, too little attention has been paid to design and operation, and it is under these two heads that the report is divided.

Points dealt with in cupola-furnace design include the following: height of charging door, internal diameter and shape of lining, and tuyères (area and arrangement). Factors affecting operation which should be closely watched comprise the height of the coke bed, the weight of the metal charge, and (if practicable) of the coke charge, the coke charge ratio (illustrated by a table), slagging, blowing down, repairs to lining, and finally overall coke consumption and coke quality.

Aluminium Casting Alloys

Effect of Minor Alloying Elements

IN a very comprehensive article in the *Iron Age*, Mr. W. Bonsack, chief metallurgist of The National Smelting Co., Cleveland, Ohio, discusses the effect of minor alloying elements on the mechanical properties of aluminium-copper, aluminium-copper-silicon, and aluminium-copper-nickel alloys. The author makes a valuable contribution in pointing out that, with the exception of magnesium and iron, which must be carefully controlled, the other alloying elements are either beneficial or innocuous. The article includes extensive references to the world's leading literature on the subject.

Wrought Steels

Amended B.S. Specification

AN important addendum has been issued to B.S. 970 which provides for three additional steels. These steels and their reference numbers are as follows: En. 100, Low Alloy Steel Bars for Machining, obtainable in tensile ranges from 45 to 65 tons per square inch. En. 101, Carbon Manganese Case Hardening Steel, with a tensile strength of not less than 40 tons per square inch. En. 102, Carbon Manganese Case Hardening Steel (for machining) with a tensile strength of not less than 40 tons per square inch. The specifications for these three steels are issued in the form of a leaflet under the reference No. PD 69 and may be obtained from the B.S.I., price 6d. each (for 12 or more copies 3d. each).

Personal Notes

DR. E. W. SMITH, C.B.E., has resigned his position as Director-General of Gas Supply at the Ministry of Fuel and Power.

BRIG-GEN. G. M. JACKSON, managing director of the Clay Cross Company, Ltd., with which he has been associated for 52 years, celebrated his golden wedding on March 1.

MR. R. I. L. BENTLEY and MR. W. J. JONES have been elected as additional members of the executive committee of the Chemical and Allied Trades Section of the Manchester Chamber of Commerce.

MISS P. V. MCKIE, at present head of the department of chemistry at Westfield College, University of London, has been appointed Principal of St. Gabriel's Church of England Training College.

MR. LESLIE GAMAGE, vice-chairman and joint managing director of the General Electric Co., Ltd., has been elected president of the Institute of Export for 1943 in succession to Sir Patrick Hannon. MR. G. T. MACEWAN and MR. T. BOYD BOYD have been elected chairman and vice-chairman respectively of the council.

PROFESSOR ALEXANDER FINDLAY, M.A., D.Sc., Ph.D., who was elected President of the Institute of Chemistry on March 1, was trained at Aberdeen, Leipzig, and University College, London. He held university teaching appointments at Birmingham, St. Andrews, and Aberystwyth, before he was appointed in 1919 to the Chair of Chemistry in the University of Aberdeen. He has for many years been an active Member of Council of the Institute, and has served on the Council of the Chemical Society.

MR. P. S. RENDALL, since 1937 a director of Courtaulds, Ltd., has been appointed an additional managing director.

The Council of the Society of Chemical Industry has decided to present to DR. LESLIE H. LAMPITT, D.Sc., F.I.C., at its next annual meeting, the Society's Medal which is awarded to eminent chemists who have rendered conspicuous services to the Society. Dr. Lampitt is the Chief Chemist and a director of J. Lyons & Co., Ltd., and under his charge are upwards of a hundred chemists whose work is mainly to ensure the highest standard of the products purchased by the company and of the foodstuffs the company sells. Dr. Lampitt has served on the Council of the Society for many years and has been its honorary foreign secretary, and is now its honorary treasurer. He is also chairman of the Chemical Council and his work has been of great value to that Council, to the Society of Chemical Industry, and to the profession of chemistry.

Dr. L. H. Lampitt.

New Control Orders

Grinding Magnesium

THE Minister of Labour and National Service has made the Magnesium (Grinding of Castings and other Articles) Order (S. R. & O. 1943, No. 268), which comes into force on March 15. The Order is designed for the protection of persons employed in grinding or polishing magnesium castings, etc. It provides that all plant in factories where work of this kind is carried on shall maintain all plant in good repair; that none of the processes shall be carried out by means of any tool which has been used for abrading ferrous material; and that adequate apparatus for the interception and removal of magnesium dust shall be installed. Such appliances shall not be deemed adequate unless they include (i) a dust-intercepting hood, (ii) a dust-removal duct which can be kept free of obstruction and properly inspected, (iii) an extraction fan, (iv) air-scrubbers installed not more than ten feet from the intercepting hood. If the grinding is done by means of a portable device, the hood shall not be required if the process is carried on in an enclosed space from which the dust is effectively removed by the other apparatus. The fans and scrubbers must have been working for five minutes before the start of the process, and automatic arrangements must ensure that no grinding device can be worked by mechanical means unless the fans and scrubbers are in effective operation. All dust, sludge, and scale must be removed from the scrubbers at least once a week, no tool containing iron to be used, and the dust, etc., collected shall be burned in the open air at least 100 feet from any factory building. Fire-resisting overalls shall be provided.

The Institute of Chemistry

Annual Meeting : New Council Members

Professor Alexander Findlay.

AT the 65th annual meeting of the Institute of Chemistry held on March 1, Dr. J. J. Fox, the retiring President, said that the Institute had been prepared at all times to assist in the war effort and had dealt with many matters arising in that connection. The roll had increased to 8250 Fellows and Associates and over 950 Students. The Institute had joined with the Institute of Physics and representatives of other sciences in forming a Joint Council of Professional Scientists to watch their common interests and give expression to the opinions of professional scientists as occasions arise. The Joint Council was in touch with the appropriate authorities in considering the probable position of scientists after the war. There had been much discussion among chemists on the future policy of the Institute and on the possibility of closer co-operation between the various organisations devoted to the science and profession. The main objects of the Institute were to promote the education and training of professional chemists, to hold examinations, to grant certificates of competency, to organise and register the competent, and to render every possible assistance to the Government, industry and commerce by encouraging the employment of chemists. The Council was determined to maintain the standard of qualification for both the Fellowship and Associateship.

More Publicity Needed

There was a demand for more publicity for the achievements of the chemist; his work was less obvious than that of the medical man, the lawyer, the engineer, and the architect, and perhaps his discoveries were not such as could readily be published at the present time. He hoped that the Council, perhaps in closer association with younger members, might do something more to encourage individuality and self-reliance, something to bring to the fore those who were fit to lead, both as scientists and men of affairs. Endeavours to promote co-operation at the present time by means of joint membership had not been so eagerly supported as had been hoped by the Chemical Council, a body constituted under a Deed of Agreement between the three largest organisations, the Institute, the Chemical Society, and the Society of Chemical Industry, which has now been asked to consider the possibility of co-ordinating the services performed by the various bodies for chemists and chemistry.

The Year's Elections

Professor Alexander Findlay, M.A., Ph.D., D.Sc., of the University of Aberdeen, was elected President, in succession to Dr. Fox, who had held the office for the full period of three years. The vice-presidents for the year are: Mr. F. P. Dunn, Dr. J. J. Fox, C.B., O.B.E., D.Sc., Dr. I. M. Heilbron, D.S.O., F.R.S., Dr. Dorothy Jordan-Lloyd, Dr. L. H. Lampitt, Mr. W. H. Roberts. Hon. treasurer: Mr. J. C. White, M.C., O.B.E.

Members of Council: Mr. R. W. Ancrum, Mr. John Andrews, Dr. E. F. Armstrong, F.R.S., Mr. E. E. Ayling, Mr. A. L. Bacharach, Dr. Harry Baines, Dr. G. N. Burkhardt, Dr. S. R. Carter, Dr. Frederick Challenger, Dr. G. R. Clemo, F.R.S., Mr. L. V. Cocks, Dr. J. W. Cook, F.R.S., Dr. J. W. Corran, Dr. William Cullen, Dr. N. M. Cullinane, Mr. G. J. Denbigh, Mr. D. A. Derrett-Smith, Mr. G. E. Dodds, Mr. George Dring, Mr. Norman Evers, Mr. Lewis Eynon, Dr. J. B. Firth, Mr. D. M. Freeland, Mr. G. F. Hall, M.B.E., Dr. R. D. Haworth, Dr. E. L. Hirst, F.R.S., Dr. H. H. Hodgson, Dr. E. B. Hughes, Mr. S. J. Johnstone, O.B.E., Mr. Osman Jones, Dr. L. A. Jordan, Dr. J. G. King, Dr. F. M. Lea, Dr. J. A. Lovern, Dr. F. G. Mann, Dr. J. I. O. Masson, M.B.E., F.R.S., Dr. Harold Moore, C.B.E., Mr. A. J. Prince, Mr. Harold Stevenson, Mr. Garfield Thomas, and Dr. F. J. Wilson.

General News

From Week to Week

The Minister of Supply has appointed an Advisory Committee to assist and advise the Rubber Controller on all matters falling within the scope of the Control.

Synthetic resin cement (gap-filling) is the subject of Specification D.T.D. 484, issued by the Ministry of Aircraft Production and published at one shilling.

The International Nickel Company has established an industrial fellowship, concerned with the preparation, properties, and uses of nickel compounds, especially organic derivatives.

The Ministry of Food announces that there will be no change in the existing prices of oils and fats allocated to primary wholesalers and large trade users during the four weeks ending March 27.

A research scholarship of the value of £400 per annum, tenable for two years, has been offered by the Wrought Light Alloys Development Association to encourage and facilitate research in the application of light alloys to ship construction. It is hoped to make the award in September.

A Glasgow chemical manufacturer, given the task of producing a peat briquette by the Scottish Committee for Fuel Economy and Efficiency, has now handed over his finished product to the committee for further investigation. The committee will, if satisfied, press for Government action.

The subject for the next Aberdeen University Blackwell Essay, the prize for which will be awarded in 1945, is announced as "Scotland's Contribution to Industrial Development by the Application of Chemical Science since the Seventeenth Century." The essay must be of about 10,000 words.

Information Bulletin No. 2, issued by the Wrought Light Alloys Development Association, is a guide to the properties of wrought light aluminium alloys. It contains information supplementing the various specifications to which almost all light alloys are now supplied. The notes under the various headings are intended for general guidance only; further bulletins giving detailed information are in course of preparation.

At a mining exhibition recently opened in Birmingham the production of coal and the involved process of oil refining were explained. Visitors were able to see how waste lubricating oil is recovered and made as good as the original product. The variety of synthetic products made from oil was of special interest. As well as solvents for general industrial purposes these include rubber, the actual production of which was demonstrated. Among other exhibits was an emergency producer gas plant.

British Bitumen Emulsions, Ltd., were last month elected members of the Manchester Chamber of Commerce.

At the request of the Chinese National Government and with the approval of H.M. Government, the F.B.I. has agreed to grant facilities for a number of war-time apprenticeships whereby Chinese engineering graduates can be trained in British workshops. About 30 vacancies have been offered by British manufacturers, and Chinese graduates are now being selected by an Anglo-Chinese Committee specially set up in Chungking.

Industrial and commercial concerns are urged to reduce the number of copies of various letters and memoranda. It is known that in some firms as many as four or even six copies are still made of certain correspondence, merely as a matter of routine, on the pretext that heads of various departments needs these copies on their files for reference purposes. If the files of the department dealing with each question could be open to other departments for reference purposes, thousands of sheets of paper could be saved in a year.

Last September it was decided that the war-damage premium payable under the business scheme for the twelve months ending September 30, 1943, would not exceed £1 per cent. For the period of six months to March 31, 1943, the rate of premium was fixed at 10s. per cent. The Board of Trade, has now, with the approval of the Treasury, decided to fix the rate of premium for the whole of the year to September 30, 1943, at 15s. per cent., so that the premium to be paid for the six months, April 1 to September 30, 1943, will be 5s. per cent.

Foreign News

A new salvage plan has been launched in the United States under which all scrap materials needed by the Government will be saved and regularly collected.

Preliminary prospecting and testing work on asbestos deposits at Asbestos Point, near Strahan, in Tasmania, covering an area of 300 acres, has been carried out by Minerals (Vic.) Pty., Ltd. Samples of the fibre are stated to be satisfactory, and further tests of the deposits will be carried out at depth.

By the Non-Ferrous Metals Control Order (dated November 25, 1942), the Government of India has ordered that no person shall deal in, or consume for manufacturing purposes, any nickel, tin, lead, zinc or spelter, or copper, in excess of stated small quantities, without a licence from the Director-General of Munitions Production.

Copper concentrates, as well as lead and zinc, are now being produced by San Francisco Mines of Mexico.

Designed to stimulate production, expand facilities, and encourage new producers to enter the fluorspar field, an increase in maximum prices for metallurgical fluorspar is announced in the United States.

A studies group has been established in France for the production of synthetic fuels with the support of the Government as "Société Central d'Hydrogénation et de Synthèse," which will erect a pilot plant for hydrogenation of lignite in the district of Fuveau.

"Metal Powder News," New York, states that hardenable steel powder metallurgical parts can be produced by mixing soft iron powder with a given percentage of carburised powder. A homogeneous steel body is the result of diffusion of the carbon during the sintering operations.

The Government of India has given an official assurance that all persons in India who are at present engaged in the manufacture of calcium carbide shall receive post-war protection against unfair competition from abroad, provided that their business is conducted on sound lines.

The Australian Government is aiming at an annual production of 10,000 tons of ingot aluminium, according to Mr. Beasley, Minister of Supply. Plant involving the expenditure of £A 3,000,000 is in view, steel requirements would be 11,000 tons, and coal consumption 35,000 tons per annum. Sufficient suitable bauxite existed to establish the industry on sound lines.

The Standard Oil Company of New Jersey have developed substitutes for palm oil and olive oil after studying their physical and chemical characteristics. The palm oil substitute has been prepared to meet the need for Spanish olive oil in American worsted mills. Palm oil is effective in cold rolling steel because of its palmitic acid and the predominance of long-chain carbon molecules, and the problem had been to find a mineral lubricant in which the carbon molecules were similarly arranged.

An American manufacturer of synthetic resins in Detroit, Henry Reichhold, is stated to be producing rubber commercially from soya beans at the rate of 250,000 lb. a month. The fatty acids from soya-bean oil are treated with ethylene glycol, and although no substitute for tyre rubber, the resultant product, known as "Agripol," makes good gaskets, belting, insulating mats, hose linings, and adhesives. Another soya-bean rubber, "Norepol," is made at the Northern Regional Laboratory of the Department of Agriculture, but cannot be used for tyres. This can also be made from cottonseed and linseed oils.

Forthcoming Events

There will be a meeting of the London section of the **Institution of the Rubber Industry** at the Caxton Hall, S.W.1, on **March 8,** at 6.30 p.m., when Dr. J. E. O. Mayne will speak on "Emulsions Prepared from Polyvinyl Acetate and its Derivatives," and Mr. A. Renfrew and Dr. C. F. Flint on "Methacrylate and Vinyl Chloride Resin Dispersions."

The **Chemical Society** (Leeds Area section) will hold a joint meeting with the Leeds University Chemical Society, in the Chemistry Lecture Theatre, Leeds University, on **March 9.** A lecture by Professor H. W. Melville on "The Synthesis of High Polymers" will be presented at 6.30 p.m.

There will be a domestic meeting of the Microbiological Panel of the Food Group, **Society of Chemical Industry,** at 2 p.m., on **March 10,** in the Chemical Society's rooms, Burlington House, when Dr. H. Martin will speak on "The Evaluation of Fungicides."

Four short papers of pharmaceutical interest will be presented at a meeting of the **Pharmaceutical Society,** at 7 p.m., on **March 11,** at 17 Bloomsbury Square, London, W.C.1.

The annual general meeting of the Bristol section of the **Society of Chemical Industry** will take place in the chemistry department of Bristol University on **March 11,** and will be followed, at 6 p.m., by a paper on "High Vacuum and Molecular Distillation," at which the local sections of the Chemical Society and the Institute of Chemistry will be present.

Professor T. P. Hilditch will speak on "Drying Oils" to the Manchester section of the **Society of Chemical Industry,** at 2 p.m., on **March 12,** in the Grand Hotel, Aytoun Street.

The annual general meeting of the **Society of Chemical Industry,** Yorkshire section, will take place in the Hotel Metropole, Leeds, at 5.45 p.m., on **March 15.** It will be followed by three short papers.

Four lectures on the modern power station will be delivered before the **Royal Society of Arts** in the near future. The first, on "The Boiler House," by Mr. C. H. Sparks, will take place at 1.45 p.m. on **March 15.**

Sir Henry Dale is to give a series of four lectures on chemistry in modern medicinal treatment before the **Royal Institution,** at 3 p.m., on Tuesdays. The first, on **March 16,** will be about "Pre-scientific Discoveries."

Dr. Dorothy Jordan Lloyd, F.I.C., is to give a lecture on "Leather" before the **Institute of Chemistry,** at 30 Russell Square, London, W.C.1, at 2.30 p.m., on **March 19.**

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

BRITANNIA LEAD CO., LTD., London, E.C. (M., 6/3/43.) January 20, letter of credit securing £150,000 (not ex.), to Mining Trust, Ltd., charged on certain silver lead bullion, etc. *$1,000,000, letter of credit not ex. £150,000. December 1, 1942.

BRITISH PLASTOIDS CO., LTD., Nottingham, plastic manufacturers, etc. (M., 6/3/43.) February 10, charge, to Barclays Bank, Ltd., securing all moneys due or to become due to the Bank; charged on 34 Beacon Street, Nottingham.

UNITED ALUMINIUM FOUNDRIES, LTD., London, W. (M., 6/3/43.) February 15. £2500 (not ex.) equitable assignment, to Lloyds Bank, Ltd., charged on moneys under orders.

UNITED CARBORUNDUM & ELECTRITE WORKS, LTD., Lincoln. (M., 6/3/43.) February 12. £5000 debentures; general charge. *Nil. January 13, 1941.

Company News

The Staveley Coal and Iron Co., Ltd., announce an interim dividend of 2½ per cent. (same) in respect of the year to June 30.

Boots Pure Drug Co., Ltd., announce an interim dividend of 10 per cent. (same) in respect of the half year to March 31.

Fisons, Ltd., announce a final ordinary dividend of 10 per cent., making 12½ per cent. (same) for the 15 months to September 30.

Borax Consolidated, Ltd., announce a final dividend of 3 per cent. on the preferred ordinary stock, making 6 per cent. for 1942, and dividend on the deferred ordinary stock of 7½ per cent. (same). The net profit was £568,483 (£544,996).

Chemical and Allied Stocks and Shares

ALTHOUGH more active conditions developed in some sections of the Stock Exchange, movements in values were again moderate in character. Sentiment was assisted by satisfaction with recent dividend announcements and financial results. Although "ex" the dividend, which is again 7½ per cent., Borax Consolidated deferred at 34s. 9d. were within 3d. of the level ruling a week ago. Dorman Long at 25s. 3d. xd. were higher on the resumption of dividends with a payment of 8 per cent. Courtaulds, however, had an easier appearance at 47s. xd., sentiment being influenced more by the lower profits than by the maintenance of the dividend. Fisons at 44s. 4½d. were unchanged on the 10 per cent. dividend which is being paid for the fifteen months to September 30 last.

Imperial Chemical improved to 38s. 6d. in response to continued market confidence that the forthcoming announcement will show maintenance of the dividend at 8 per cent. B. Laporte were firm at 78s., and W. J. Bush were again quoted at 50s. "middle," but British Aluminium eased to 49s. 3d. British Oxygen were well maintained at 76s. 9d., and elsewhere Birmid Industries further improved to 83s., while Barry & Staines were better at 39s. Following their recent reaction, Wall Paper Manufacturers deferred units developed a firmer appearance at 35s., while International Paint remained firm around 107s. on the announcement that the dividend total is again 20 per cent. Turner & Newall at 75s. 3d. were slightly lower on balance, but elsewhere the units of the Distillers Co. at 85s. 9d. regained part of their recent reaction. Stewarts & Lloyds deferred were 54s. 1½d., and Tube Investment 92s. 9d. Awaiting the results, General Refractories 10s. shares showed further improvement from 14s. to 14s. 7½d.

Among shares of companies associated with plastics there was again a fair amount of activity, but movements on balance were small. British Industrial Plastics 2s. ordinary were 5s. 6d., Lacrinoid Products 4s. 9d., and Erinoid 5s. ordinary around 11s. Elsewhere, Lever & Unilever had a steady appearance at 34s. 6d. Dealings around 19s. 9d. were recorded in Burt Boulton, up to 10s. 6d. in Lawes Chemical 10s. shares, and Greeff-Chemicals Holdings 5s. units were quoted at 6s. 3d. British Drug Houses were again 22s. 6d., Blythe Colour 7s., and William Blythe 3s. ordinary around 7s. 6d. At 31s. 10½d. Triplex Glass 10s. ordinary regained part of their recent decline. United Glass Bottle were firm around 61s. 3d. awaiting the dividend announcement, and Canning Town Glass 5s. ordinary held their improvement to 7s. 7½d. Goodlass Wall 10s. ordinary remained steady at 12s. 9d., and elsewhere, Morgan Crucible 5½ per cent. first preference maintained their improvement to 26s. 3d. Monsanto Chemicals 5½ per cent. preference were again 22s. 6d. Leeds Fireclay 6 per cent. non-cumulative preference remained at 14s. aided by the recent decision to resume dividends with an interim payment of 3 per

cent. Johnson Matthey 5 per cent. preference were 23s. 3d.

Boots Drug 5s. ordinary were again steady at 40s.; these shares show only a small yield but this reflects general recognition of the strength of the balance-sheet position, and the assumption is that, after the war, the distribution of an annual cash bonus may be resumed. Sangers 5s. ordinary were 21s. 4½d., and Timothy Whites 27s. 4½d. British Match remained firm at 38s. 3d., and Imperial Smelting were again 13s., but Dunlop Rubber eased slightly to 34s. 6d. Associated Cement were again 57s. 6d. British Plaster Board 5s. ordinary were at the slightly higher level of 27s. Oil shares were inclined to reflect the firmer tendency of Stock Exchange markets.

British Chemical Prices

Market Reports

TRADING conditions in the general chemicals market may be characterised as steady with a moderate weight of fresh business in evidence in most sections. Makers' deliveries against contract specifications are regarded as satisfactory and a fair number of contract renewals have been made. An active market exists for the majority of the soda compounds, with soda ash and bicarbonate of soda in good call. A steady trade is passing in acetate of soda, while offers of chlorate of soda are insufficient to meet current demands. Prussiate of soda remains scarce. Most of the potash products are available in restricted quantities, with nominal prices ruling for yellow prussiate of potash, and a brisk inquiry is reported for permanganate of potash. There is no change to report in the acid section. Conditions in the coal-tar products market are perhaps a little less active than of late, due more to the scarcity of offers than any lack of buying interest. There is, however, no falling off in contract deliveries, and the position in this respect appears to be proceeding satisfactorily.

MANCHESTER.—New inquiries on the Manchester chemical market during the past week have resulted in moderate additions to order-books in the bread-and-butter lines, though the general movement of supplies is against contracts, which are on a fairly extensive scale. The soda products generally are in steady demand and there is a ready outlet for anything in the potash section that becomes available, while a brisk demand is reported in sulphuric and hydrochloric acids, borax and alum. In tar products contracts are being steadily drawn against in most sections, but traders here indicate relatively quiet conditions so far as new bookings are concerned.

GLASGOW.—There has been a general improvement in the position in the Scottish heavy chemical trade during the past week for home business. Export trade still remains rather restricted. Prices continue to be very firm with no actual changes.

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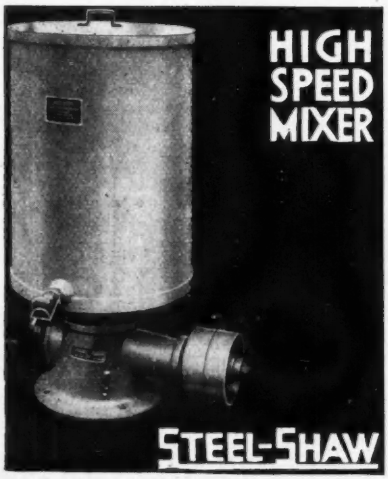

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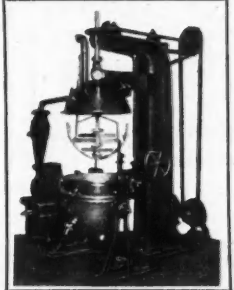

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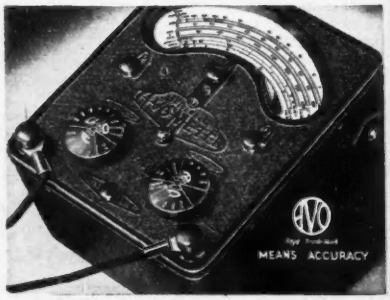

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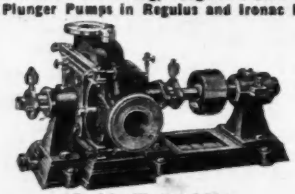

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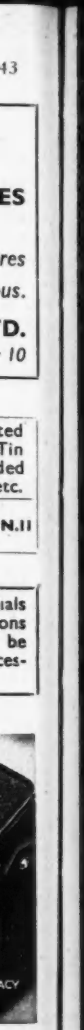

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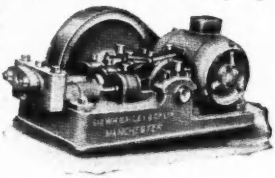

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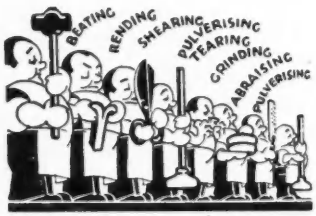

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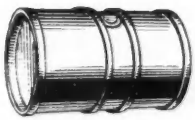

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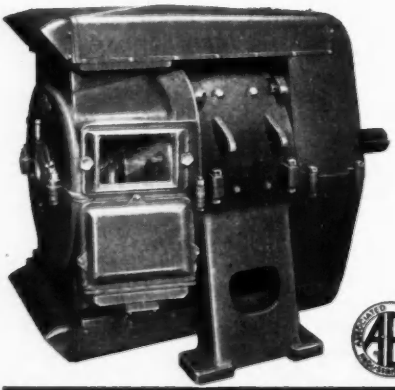

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Printed in Great Britain by THE PRESS AT COOMBELANDS, LTD., London and Addlestone, and published by BENN BROTHERS, LTD., at Bouverie House, 154, Fleet Street, E.C.4., March 6th, 1943. Entered as Second Class Matter at the New York, U.S.A., Post Office.